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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention is used for the manufacturing installation of semiconductor devices, such as an etching system, and relates to the wafer stage equipped with the electrostatic chuck which carries out adsorption maintenance of the wafer, and this electrostatic chuck.
[0002]
[Description of the Prior Art] In recent years, the art which reconciled the high selection ratio to high precision micro processing and the ground which the demand to micro processing in a VLSI is still severer, for example, the size conversion difference was suppressed infinite about etching processing is indispensable. By the way, about reservation of the anisotropy configuration at the time of carrying out plasma etching of the material other than an oxide-film system, it is made by existence of the so-called side-attachment-wall protective coat as everyone knows. That is, this side-attachment-wall protective coat achieves the duty of preventing depositing and forming in the side attachment wall of a pattern various sediments including the organic polymer formed because the resultant generated at the time of plasma etching re-dissociates in plasma, protecting the side attachment wall of this pattern, and this side attachment wall **********ing.
[0003] However, since this side-attachment-wall protective coat is formed with the sediment from a resultant, by the case where the pattern formed of etching is a convex, if the width of face is thin, it will become thick [a side-attachment-wall protective coat] too much relatively, and will be made thicker than the width of face which asks for the whole pattern width of face. Similarly, in the case where the pattern formed of etching is a concave, if the width of face is narrow, it will become thick [a side-attachment-wall protective coat] too much relatively, and it will be made still narrower than the width of face which asks for the whole pattern width of face. Therefore, when detailed-ization of various patterns progressed as mentioned above, pattern width of face became thin (narrowly) and it is going to secure the anisotropy of etching using a side-attachment-wall protective coat, the dimensional accuracy of the pattern obtained will fall.
[0004] By etching performing high-speed exhaust air recently, in order to solve such un-arranging, the attempt in which a dimensional accuracy is secured is made and attracts attention. By attaching a pump with a bigger exhaust speed than the conventional etching processor, and improving the conductance of etching gas, this high-speed exhaust air process shortens the residence time (residence time) of the etching gas under etching processing, and suppresses that a resultant re-dissociates in plasma during etching processing. And according to such a high-speed exhaust air process, since the sediment by the re-maceration of a resultant can be reduced sharply, the absolute value and dispersion of a size conversion difference can be suppressed very effectively.
[0005] However, in the aforementioned high-speed exhaust air process, since a resultant is exhausted promptly, the source of supply of a side-attachment-wall protective coat decreases, and a side-attachment-wall protective coat is not formed in sufficient thickness but reservation of an anisotropy configuration becomes inadequate, the new technical problem that the configuration precision of the pattern obtained when over etching is performed gets worse has been produced. That is, if substrate impression bias is reduced in order to secure a selection ratio with a ground at the time of over etching, since a side-attachment-wall protective coat is thin, therefore weak, generating of side etch or notching will no longer be avoided, and if impression bias is conversely made high for configuration reservation, a selection ratio with a ground will fall shortly.
[0006] thus, the problem from which the selection ratio and the configuration serve as a relation of a trade-off is solved, and the so-called low-temperature etching technology which cools the wafer temperature at the time of etching at 0 degree C or less is proposed by making a selection ratio and an anisotropy configuration into compatible technology this low-temperature etching technology -- for example, Mr. Taji -- ** -- it was reported by the group (** in Hitachi) (1988 DRYPROCESS SYMPOSIUM "Low-Temperature Microwave Plasma Etching"), and radical reaction is suppressed and it enables it to secure an anisotropy also under low substrate bias by reducing sample temperature
[0007]
[Problem(s) to be Solved by the Invention] However, even if it is in this low-temperature etching technology, there is un-arranging [which is described below]. To the material from which the vapor pressure of a resultant differs like W polycide, the processing is difficult for the 1st. because -- if it hits **********ing W polycide -- WSix etching -- WClx sometimes produced the bottom and WOx Cly etc. -- although contest polysilicon is **********ed, if the vapor pressure of a resultant low-temperature-izes a sample to convenient temperature for a low reason -- WSix It is because etching becomes impossible.
[0008] deltaT (difference of the setting temperature of a sample base and wafer temperature) will become large the 2nd at the

time of etching. That is, for example in processing of a contact hole, although low-temperature-izing is effective for selection-ratio reservation with Ground Si, as mentioned above, a setup of a low temperature service is difficult, in order to cut Si-O bond with processing of a contact hole, it will surely be necessary to enlarge incidence energy, and, moreover, this will cause elevation of deltaT from low temperature-ization causing taper-ization of the contact hole configuration by superfluous polymer deposition. Although it is such an inconvenient shell and low-temperature etching, etching is therefore, impossible only at halfway temperature in fact.

[0009] It is possible to change the setting temperature of the sample which consists of a wafer etc. between [in order to cancel such un-arranging, while **********ing the material from which the vapor pressure of a resultant differs, respectively] just etching and over etching etc. However, in making a change of such setting temperature in the midst of etching processing, naturally, a throughput will become small and will cause disadvantage in cost. Therefore, it is anxious for offer of the mechanism which made possible the rapid temperature fall and the rapid temperature up as could change the temperature of a wafer in a short time so that there might be no influence in a throughput. The place which this invention is made in view of the aforementioned situation, is a thing, and is made into the purpose is to offer the electrostatic chuck which enabled it to change the temperature of a wafer for a short time, and a wafer stage, without affecting a throughput.

[0010]

[Means for Solving the Problem] It made into the solution means of the aforementioned technical problem to have been equipped this invention with the heater which is made paying attention to the advantage of the aforementioned low-temperature etching technology, is arranged in this electrode [which consists of a dielectric which consists of an insulating material, and a conductor arranged in the this bottom by the electrostatic chuck according to claim 1], and electrode bottom, and heats the aforementioned dielectric. According to this electrostatic chuck, since the heater is united with the electrostatic chuck, heat gets across to a dielectric through an electrode promptly by heating at a heater, and the wafer laid and held on the dielectric by this is heated promptly.

[0011] Since it becomes possible to form an electrode in **** while it curses since the aforementioned dielectric is fixed as the aforementioned electrode, for example, and you may form by the layer and junction of a dielectric and an electrode becomes certain in that case and consists of a metal with this electrode good [of brazing filler metal, i.e., thermal conductivity,] moreover, or an alloy, heat conduction from a heater to a dielectric becomes much more prompt. About the aforementioned dielectric, although a sintered compact may be used as it is, this may be formed by the spraying process, for example, and while the flexibility which is in charge of manufacture in that case becomes large, it becomes in cost and advantageous. Moreover, the disk section which forms the adsorption side of a wafer about the configuration, for example, If these are arranged as it is good also as a thing with the tubed part which extended toward the lower part from the side periphery and the side periphery of the aforementioned electrode is covered by this tubed part in that case For example, when this electrostatic chuck is used for the plasma treatment by plasma treatment equipment, it is prevented that a leakage current occurs on the electrode side by plasma.

[0012] About installation of the heater to the aforementioned electrode, a heater may be formed through the insulator of high temperature conductivity among these, and alumimium nitride is made suitable as an insulator in that case. Thus, it is protected from an electrode by making an insulator intervene between an electrode and a heater that current flows to a heater, and since an insulator is high temperature conductivity (the thermal conductivity of alumimium nitride is 0.235 [cal/cm-sec and **]), delay of heat conduction from the heater by this insulator is suppressed.

[0013] Moreover, as the aforementioned heater, it is good also considering this as a thin film-like thing, and it is desirable to prepare a metal plate between the aforementioned insulator and heaters or in the heater bottom in that case. Thus, although a heater is a thin film-like by preparing a metal plate, it becomes possible to fully hold the mechanical strength of the electrostatic whole chuck. Moreover, it functions as a heat exchanger plate which the aforementioned metal plate tells a heater side that the cold energy from a metal jacket etc. is when put on the metal jacket which this static chuck equipped with the cooling means, for example when it functioned as a heat exchanger plate to which this metal plate conducts the heat from a heater promptly to an insulator when a metal plate is in the heater bottom and a metal plate was in the heater bottom.

[0014] Although the heat-conducting characteristic also becomes low while the mechanical strength of the whole heater becomes low when it not only made the heater into the shape of a thin film especially, but forms spirally, it becomes possible by preparing a metal plate, as mentioned above to compensate the fall of these functions. Furthermore, when the aforementioned insulator is formed by alumimium nitride, as the aforementioned metal plate, it becomes what functions as this metal plate having mentioned above enough as a heat exchanger plate and is desirable to use what thermal conductivity becomes from 0.37 [cal/cm-sec and **] and large molybdenum. Moreover, un-arranging [that a crack and exfoliation produce molybdenum in the dielectric which originates in this heat stress and is arranged on an insulator or this from coefficient of linear expansion having 5.7x10-6/degree C and the coefficient of linear expansion near ceramics (alumimium nitride being 5.1x10-6/degree C) even if it will receive the heat stress by the repeat of cooling and heating etc., if molybdenum is used for a metal plate in this way] is stopped.

[0015] Moreover, the tubed part which extended the aforementioned insulator toward the lower part to the side periphery is prepared and formed, and it may be made to arrange the aforementioned heater inside this tubed part, and from the ability of the side of a heater to be certainly worn by the tubed part in that case, when this electrostatic chuck is used for the plasma treatment by plasma treatment equipment, for example, it is prevented that a leakage current occurs on the side of a heater by plasma. Furthermore, when preparing the flange which extended toward the method of outside [edge / soffit / the] to the aforementioned tubed part, the insulator was mechanically reinforced by this flange.

[0016] Moreover, it made into the solution means of the aforementioned technical problem to have prepared the electrostatic chuck which comes to have the electrode which consists of a dielectric which consists of an insulating material, and a conductor

arranged in the this bottom, and the heater which is arranged by this electrode bottom and heats the aforementioned dielectric on the metal jacket equipped with the cooling means on the wafer stage according to claim 13 in this invention. Since the electrostatic chuck of the claim 1 aforementioned publication is prepared on the metal jacket equipped with the cooling means according to this wafer stage, it becomes possible it not only to heat a wafer promptly at the heater formed in the electrostatic chuck, but to cool a wafer through an electrostatic chuck with a metal jacket.

[0017]

[Embodiments of the Invention] Hereafter, this invention is explained in detail. Drawing 1 is drawing showing the example of 1 operation form of the wafer stage of this invention, and the sign 1 in drawing 1 is a wafer stage. On the metal jacket 2, installation fixation of the electrostatic chuck 3 used as the example of 1 operation form of the electrostatic chuck of this invention is carried out, and this wafer stage 1 is constituted. The metal jacket 2 was equipped with a cooling means (illustration abbreviation) to mention later, was formed, and, thereby, has conducted the cold energy from a cooling means to the electrostatic chuck 3 on it.

[0018] The electrostatic chuck 3 is the thing of the shape of an approximate circle pillar (disk) which comes to have the electrode 5 which consists of a dielectric 4 which consists of an insulating material, and a conductor prepared in the undersurface of this, and the heater 6 arranged under this electrode 5, makes an insulator 7 intervene between an electrode 5 and a heater 6, and is constituted. A dielectric 4 is a disc-like thing with a thickness of about 0.2mm formed from ceramic boards, such as an insulating material with high thermal conductivity, for example, sapphire, (thermal conductivity; 0.1 [cal/cm-sec and **]), and an alumina (thermal conductivity; 0.05 [cal/cm-sec and **]), and consists of a sintered compact produced beforehand in this example.

[0019] Although the electrode 5 was not limited especially when the metal, the alloy, etc. consisted of a conductor, it was formed in this example of brazing filler metal with a thickness of about 0.5mm which cursed since a dielectric 4 was fixed on the aforementioned insulator 7, and was prepared between the layer 7, i.e., an insulator, and the dielectric 4. Specifically, the alloy which consists of titanium, tin, antimony, and magnesium is mentioned as this brazing filler metal. In addition, to this electrode 5, although not shown in drawing 1 , it connects with the high voltage power supply through wiring, and if direct current voltage is impressed to this electrode 5 by this, the aforementioned dielectric 4 will demonstrate an adsorption power.

[0020] In this example, an insulator 7 has flange 7c which extended toward the method of outside [edge / soffit / of disk section 7a which contacts the aforementioned electrode 5, i.e., a soldering layer, tubed part 7b which extended toward the lower part from the side periphery of this disk section 7a, and this tubed part 7b], was formed, and is formed in about 2mm in thickness as a whole. Moreover, this insulator 7 was formed from the insulating material which has high temperature conductivity, and alumimium nitride (AlN) (thermal conductivity; 0.235 [cal/cm-sec and **]) is mentioned as such an insulating material. In addition, in this example of an operation form, the insulator 7 is formed from alumimium nitride.

[0021] In this example of an operation form, the heater 6 is what was formed in the shape of a plane view spiral by HITOROI which is the alloy which consists of Fe, Cr, and aluminum, is a thin film with a thickness of about 0.1mm, and is formed in width of face of about 2-3mm. In addition, although not illustrated at this heater 6, the power supply is connected to it through wiring, and generation of heat of about 2kW is made by this. Moreover, the insulating material 8 is embedded by the gap of the heater pattern which becomes spiral at this heater 6, and the heater 6 has become what formed the disk configuration in the state where it was reinforced by the insulating material 8 by this. Here, as an insulating material 8, alumimium nitride is used in this example of an operation form.

[0022] Moreover, metal plate 9a is stuck on the upper surface, and metal plate 9b is stuck on the undersurface at the thing of the disk configuration which consists of this heater 6 and insulating material 8, respectively. And the heater 6 which did in this way and was fastened to metal plates 9a and 9b was dedicated without the crevice in tubed part 7b of the aforementioned insulator 7 with these metal plates 9a and 9b. Here, as metal plates 9a and 9b, in order [which tells the heat from a heater 6 promptly to a dielectric 4 side] to tell a heater 6 side promptly that the cold energy from the metal jacket 2 sake or mentions later, the large metal or large alloy of thermal conductivity is made suitable, and the molybdenum board with a thickness of about 2mm is used in this example of an operation form. Moreover, the insulating coat (illustration abbreviation) which consists of an oxide film etc. is prepared in the inside, i.e., the field by the side of a heater 6, respectively, and it is prevented by these metal plates 9a and 9b that the electrical and electric equipment flows from a heater 6 to metal plates 9a and 9b by this. Moreover, metal plate 9a is joined to the insulator 7 by soldering, and metal plate 9b was similarly joined to the aforementioned metal jacket 2 by soldering. Here, specifically, the alloy which consists of titanium, tin, antimony, and magnesium is mentioned like the brazing filler metal used as the aforementioned electrode 5 as metal plate 9a and brazing filler metal to 9b Curse and which is used for attaching.

[0023] In addition, in this electrostatic chuck 3, between a dielectric 4 and insulators 7 is covered with the insulator (illustration abbreviation) which consists of a resin etc. so that the side periphery of the electrode 5 which consists of a soldering layer may not be outside exposed. And when this electrostatic chuck 3 is used for the plasma treatment by plasma treatment equipment by covering the side periphery of an electrode 5 with the insulator (illustration abbreviation) in this way, it is prevented that a leakage current occurs in the side periphery of an electrode 5 by plasma. Moreover, the frequent appearance mechanism (illustration abbreviation) in which the pusher pin (illustration abbreviation) for pushing up the wafer by which installation maintenance is carried out is laid underground on a dielectric 4, and you make this project on the field of a dielectric 4 at this pusher pin further, or make it buried in the bottom of this field is connected to this electrostatic chuck 3.

[0024] Next, the operation of the wafer stage 1 equipped with such an electrostatic chuck 3 is explained based on the example used for the plasma etching system 10 which shows the wafer stage 1 of this example of an operation form to drawing 2 . When a plasma etching system (it is hereafter called an etching system for short) 10 is explained, first, this etching system 10 It is what was constituted by having the helicon wave plasma generation source which installed RF antenna in two places, and the stage

which can move in the vertical direction. The diffusion chamber 11 and the RF antennas 12 and 12 formed in the upper part of this diffusion chamber 11, It has the RF antenna 13 installed in the shape of a loop on top-plate 11a of the diffusion chamber 11, and the multipole magnet 14 which forms the cusp field for being prepared in the lower outside of the diffusion chamber 11, and suppressing disappearance with the wall of electron.

[0025] The RF antennas 12 and 12 are the things of the antenna configuration goes around the outside of a bell jar 15 which consists of cylinder-like ****** with a diameter of 350mm formed in the upper part of the diffusion chamber 12, and is established, and the plasma in the M= 1 mode stands. The solenoid-coil assembly 16 which consists of an inner circumference coil and a periphery coil is arranged in the outside of these RF antennas 12 and 12. An inner circumference coil is contributed to propagation of a helicon wave among this solenoid-coil assembly 16, and a periphery coil is contributed to transportation of the generated plasma. Moreover, the power supply 18 is connected to the RF antennas 12 and 12 through the matching network 17, and the power supply 20 is connected to the RF antenna 13 through the matching network 19.

[0026] Moreover, in the diffusion chamber 11, the aforementioned wafer stage 1 for carrying out support fixation of the wafer W used as a sample is formed, and the exhaust port 21 for exhausting the gas in the diffusion chamber 11 further is connected and formed in negative pressure meanses (illustration abbreviation), such as a vacuum pump. The bias power supply 22 for controlling the incidence ion energy to Wafer W is connected to the wafer stage 1.

[0027] Moreover, a chiller 25 is connected to the aforementioned metal jacket 2 of this wafer stage 1 through the refrigerant piping 23 and 24, and the fluorescence fiber thermometer 26 for measuring the temperature of Wafer W further is connected to it. A chiller 25 receives the refrigerant which supplied the gas refrigerant -100 degrees C or less which consists of helium gas etc. to the metal jacket 2 of the wafer stage 1 through the refrigerant piping 23, and was returned from the metal jacket 2 through the refrigerant piping 22, cools this to predetermined temperature further, and cools the wafer W in which support fixation was carried out by circulation of such a gas refrigerant on the wafer stage 1. That is, the cooling means in this invention is further constituted by these chillers 25, the refrigerant piping 23 and 24, and the gas refrigerant through which you are made to circulate from a chiller 25 by the metal jacket 2.

[0028] The electronics control bulb 27 which can operate very low temperature is arranged in the refrigerant piping 23 connected to the chiller 25, and the electronics control bulb 27 which can operate very low temperature is arranged also in the bypass piping 28 between the refrigerant piping 23 and the refrigerant piping 24. The degree of cooling here of Wafer W is controlled by the flow rate of the refrigerant supplied from a chiller 25. That is, in order to cool to the temperature which cools the metal jacket 2 of the wafer stage 1, and asks for the temperature of Wafer W, the degree of opening and closing of the aforementioned electronics control bulbs 27 and 27 is controlled by the control unit 29 to become an experiment and calculation from a difference with the temperature of the wafer W which detected the temperature detected with the fluorescence fiber thermometer 26 with the control unit (PID controller) 29, and was set up beforehand here beforehand with the gas refrigerant flow rate by which a **** decision was in addition, drawing 2 -- setting -- etching gas introduction -- the illustration is omitted about equipment details, such as a hole and a gate valve

[0029] Next, an example of the dry etching art using such an etching system 1 is explained with reference to drawing 3 (a) - (c). This art is a method of processing W polycide by etching processing of two steps. That is, this example is SiO2 on a silicon substrate 30, as shown in drawing 3 (a). They are the polysilicon contest layer 32 and WSix on a film 31. W polycide which consists of a layer 33 is formed. It is what carries out etching processing of the W polycide of the wafer W which furthermore formed the photoresist pattern 34 on this, and processes this into the pattern configuration corresponding to the photoresist pattern 34. Over etching by low temperature is performed as the 2nd step which continues main etching by the elevated temperature a little from ordinary temperature as the 1st step.

[0030] First, it is WSix, as main etching of the 1st step by the elevated temperature (50 degrees C) is performed a little on condition that [ordinary temperature] the following and it is shown in drawing 3 (b). The etching removal of a layer 33 and the polysilicon contest layer 32 is changed into the state where it left a part of polysilicon contest layer 32.

- The 1st step (main etching)

Etching gas ; Cl2 / O2 450/50sccm ** ; 10mTorr Source power ; 1500W RF bias ; 100W In addition, 50 degrees C Wafer stage temperature; about a wafer temperature control here While heating at the heater 6 of the electrostatic chuck 3 with which the wafer stage 1 was equipped, cooling by the chiller 25 is also performed and wafer temperature is finely tuned by cooling control by the control unit 29 especially mentioned above.

[0031] Next, in order to perform over etching processing of the 2nd step following this 1st step, the electric discharge in an etching system 10 is once cut, and the gas which remains in a diffusion chamber 11 is exhausted from an exhaust port 21. And the etching gas (the same gas as the 1st step is used in this example of an operation gestalt) used for the 2nd step mentioned later is introduced in a diffusion chamber 11, this gas is stabilized, and the inside of a diffusion chamber 11 is adjusted to a fixed pressure. Moreover, immediately, if etching processing among such a series of operations (i.e., the 1st step) is completed, while stopping the energization to the aforementioned heater 6, the close by-pass bulb completely of the electronics control bulb 27 of the bypass piping 28 in the cooling system by the aforementioned chiller 25 is carried out, the electronics control bulb 27 of the refrigerant piping 23 is opened further fully, a gas refrigerant -100 degrees C or less is supplied to the metal jacket 2 from a chiller 25, and Wafer W is cooled quickly.

[0032] Then, the wafer stage 1 reached -50 degrees C which is the etching temperature later mentioned in a short time of about 30 seconds by such quick cooling. As mentioned above, this on the wafer stage 1 of this invention Metal plate 9b made from molybdenum with high thermal conductivity is joined to the metal jacket 2 by soldering. Moreover, since metal plate 9a made from molybdenum prepared on metal plate 9b through the heater 6 of a thin film is joined to the insulator 7 by soldering It is

because the cold energy from the metal jacket 2 gets across to an insulator 7 promptly through metal plate 9b, a heater 6, and metal plate 9a. Furthermore, it is because the cold energy which got across to the insulator 7 since this insulator 7 was formed from alumimium nitride with high thermal conductivity and the electrode 5 was formed of the soldering layer gets across to a dielectric 4 promptly through an insulator 7 and an electrode 5.

[0033] In addition, after cutting a series of operations mentioned above, i.e., electric discharge, the residual gas in the diffusion chamber 2 is exhausted, and a series of still newer operations of carrying out etching gas introduction and stabilizing this do not have the factor and bird clapper to which the time which this quick cooling takes delays the time which etching processing of Wafer W takes from this thing more than the time that quick cooling takes, or the almost same time.

[0034] Then, it is SiO_2, as it discharges again, over etching of the 2nd step by low temperature (-50 degrees C) is performed on the following conditions and it is shown in drawing 3 (c). Etching removal of a part of polysilicon contest layer 32 which remained in the state where it exposed on the film 32 is carried out.

- The 2nd step (over etching)

Etching gas ; Cl_2 / O_2 450/50sccm ** ; 10mTorr Source power ; 1500W RF bias ; 10W Wafer stage temperature; -50 degrees C

[0035] Thus, if over etching processing is performed, even if it can suppress radical reaction by low temperature-ization even if the side-attachment-wall protective coat formed is thin, therefore it can be equal now to a superfluous radical attack and it makes low impression bias to 100W to 10W, and Wafer W from this etching processing being processing under low-temperature cooling compared with the 1st step, generating of an undercut or notching can be suppressed. Therefore, SiO_2 which serves as a ground, without affecting a configuration also under 100% of over-etching Receiving and securing 100 or more selection ratios, as shown in drawing 3 (c), sufficient anisotropy configuration is securable.

[0036] Thus, if it is in the dry etching art using the wafer stage 1 of this invention It can reconcile, a high selection ratio, and reservation of an anisotropy configuration, i.e., high precision micro processing. And since wafer temperature can moreover be easily changed between steps by performing each step by the same etching system 10 for a short time Within a time [which a series of operations of a halt of electric discharge, change of etching gas, etc. between steps take], Or dry etching processing which consists of two or more steps can be performed quickly, without being able to make a temperature change in time near this, therefore reducing a throughput.

[0037] Moreover, when the same processor performs the same processing repeatedly continuously to a new wafer after etching processing of such two steps is completed, after completing the 2nd step and taking out the sample after processing, it precedes paying a new sample in the diffusion chamber 11, and the wafer stage 1 is adjusted to the sample setting temperature (wafer stage setting temperature) in the 1st step in the first step and this example. In the aforementioned example, namely, having made sample setting temperature into -50 degrees C at the 2nd step While energizing at the heater 6 of the electrostatic chuck 3, and heating the wafer stage 1 whole (especially dielectric 4 side) and opening the electronics control bulb 27 of the bypass piping 28 in the cooling system by the chiller 25 fully The close by-pass bulb completely of the electronics control bulb 27 of the refrigerant piping 23 is carried out, and rapid heating of the wafer stage 1 is carried out by the method of stopping supply of the gas refrigerant from the chiller 25 to the metal jacket 2.

[0038] Then, after etching processing of one wafer is completed, time until it starts for etching processing of a new sample can be shortened. If a temperature change of the wafer stage 1 is made even at the setting temperature in time near within a time until it conveys a new wafer in the diffusion chamber 11 especially, or this Dry etching processing which consists of two or more steps in the state where the efficiency of sufficient productivity was secured can be performed without reducing a throughput. Incidentally, according to the wafer stage 1 of this example of an operation form, heating to -50 degrees C to 50 degrees C was able to be performed in a short time called for about 40 seconds by having considered as the structure where it has good thermal conductivity as mentioned above.

[0039] Therefore, if it is in the wafer stage 1 of this invention By the heater 6 united with the electrostatic chuck 3, and the cooling means of the metal jacket 2, since rapid heating and quick cooling are possible Without requiring a long time, a temperature switch of Wafer W can be performed in a short time of about 30 - 40 seconds, and the advantage of low-temperature etching can fully be harnessed from the ability of different temperature by this to be etched almost continuously.

[0040] Coefficient of linear expansion as metal plates 9a and 9b Moreover, 5.7x10-6/degree C, Since the molybdenum which has a value near the coefficient of linear expansion (5.1x10-6/degree C) of the alumimium nitride which forms an insulator 7 is used, even if the wafer stage 1 receives the heat stress by the repeat of cooling and heating etc. It originates in this heat stress and can suppress that a crack and exfoliation arise in the dielectric 4 arranged on an insulator 7 or this. Furthermore, between the metal jacket 2 and metal plate 9b, between metal plate 9a and insulators 7, Since between [all] an insulator 7 and dielectrics 4 are furthermore joined by soldering, the coefficient of linear expansion of these brazing filler metal so that it may become a value between the coefficient of linear expansion of alumimium nitride, and the coefficient of linear expansion of molybdenum Or by adjusting so that it may become a value near these, the influence of the heat stress accompanying heating and cooling of the wafer stage 1 can be eased more certainly.

[0041] In addition, although the dielectric 4 was formed in disc-like in the aforementioned example of an operation form, without being limited to this, for example, this invention is made into a configuration with tubed part 4a which extended toward the lower part from the side periphery of a disc-like portion, as the two-dot chain line in drawing 1 shows, and is good at this tubed part 4a as for a method of a wrap in the side periphery of the aforementioned electrode 5. And from the ability of the side periphery of an electrode 5 to be covered by tubed part 4a instead of the insulator in the aforementioned example of an operation form also in that case, when this electrostatic chuck is used for the plasma treatment by plasma treatment equipment, for example, it can prevent that a leakage current occurs in the side periphery of an electrode 5 by plasma.

[0042]
[Effect of the Invention] Since the wafer held [which were held, and heat got across to the dielectric promptly through the electrode by heating according to a heater as explained above, when the static chuck of this invention united the heater with the electrostatic chuck, and was laid] on the dielectric by this was heated promptly, when this is used for an etching system, for example, the temperature switch to an elevated temperature [low temperature] can be performed in a short time.
[0043] Since the wafer stage of this invention prepares the aforementioned electrostatic chuck on the metal jacket equipped with the cooling means, it can perform etching which fully harnessed the advantage of low-temperature etching by being made to perform etching of temperature different, for example continuously from the ability for not only heating but cooling being performed promptly, therefore performing a temperature switch of a wafer in a short time, without receiving a bad influence in a throughput.

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] The electrostatic chuck characterized by having the electrode which consists of a dielectric which consists of an insulating material, and a conductor arranged in the this bottom, and the heater which is arranged in this electrode bottom and heats the aforementioned dielectric.
[Claim 2] The electrostatic chuck according to claim 1 to which it curses since the aforementioned electrode fixes the aforementioned dielectric, it is formed of a layer, and is characterized by the bird clapper.
[Claim 3] The electrostatic chuck according to claim 1 to which the aforementioned dielectric is formed of a spraying process, and is characterized by the bird clapper.
[Claim 4] The electrostatic chuck according to claim 1 to which the aforementioned heater is formed through the insulator of high temperature conductivity between the aforementioned electrodes, and is characterized by the bird clapper.
[Claim 5] The electrostatic chuck according to claim 4 which the aforementioned heater is a thin film-like thing, and a metal plate is prepared between this heater and the aforementioned insulator, and is characterized by the bird clapper.
[Claim 6] The electrostatic chuck according to claim 4 which the aforementioned heater is a thin film-like thing, and a metal plate is prepared in this heater bottom, and is characterized by the bird clapper.
[Claim 7] The electrostatic chuck according to claim 4 which it comes to have the tubed part to which the aforementioned insulator went caudad from the side periphery, and extended, and the aforementioned heater is arranged inside this tubed part, and is characterized by the bird clapper.
[Claim 8] The electrostatic chuck according to claim 4 which have the flange which has the tubed part to which the aforementioned insulator went caudad and extended from the side periphery, and extended toward the method of outside [edge / soffit / of this tubed part], it comes to be formed, and the aforementioned heater is arranged inside the aforementioned tubed part, and is characterized by the bird clapper.
[Claim 9] The electrostatic chuck according to claim 4 to which the aforementioned insulator is characterized by the bird clapper from alumimium nitride.
[Claim 10] The electrostatic chuck according to claim 5 to which the aforementioned metal plate is characterized by the bird clapper from molybdenum by the aforementioned insulator consisting of alumimium nitride.
[Claim 11] The electrostatic chuck according to claim 6 to which the aforementioned metal plate is characterized by the bird clapper from molybdenum by the aforementioned insulator consisting of alumimium nitride.
[Claim 12] It is the electrostatic chuck according to claim 1 to which it comes to have the tubed part to which the aforementioned dielectric went caudad and extended from the side periphery, and the side periphery is covered by this tubed part, and the aforementioned electrode is characterized by the bird clapper.
[Claim 13] The wafer stage characterized by preparing the electrostatic chuck which comes to have the electrode which consists of a dielectric which consists of an insulating material, and a conductor arranged in the this bottom, and the heater which is arranged by this electrode bottom and heats the aforementioned dielectric on the metal jacket equipped with the cooling means.

[Translation done.]